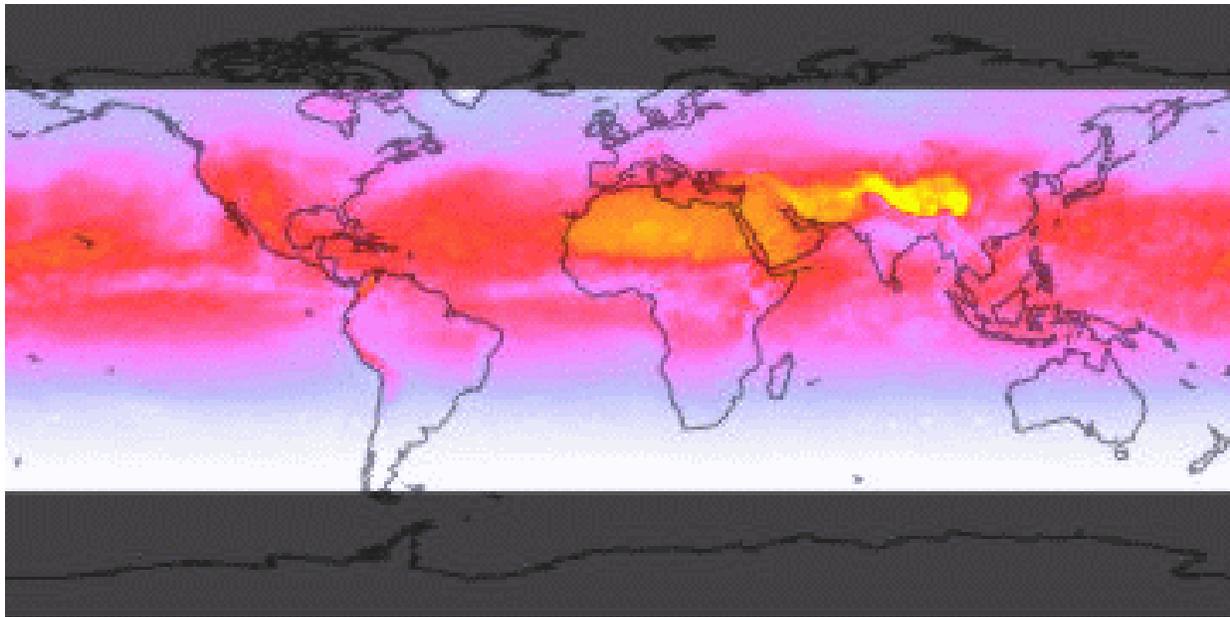
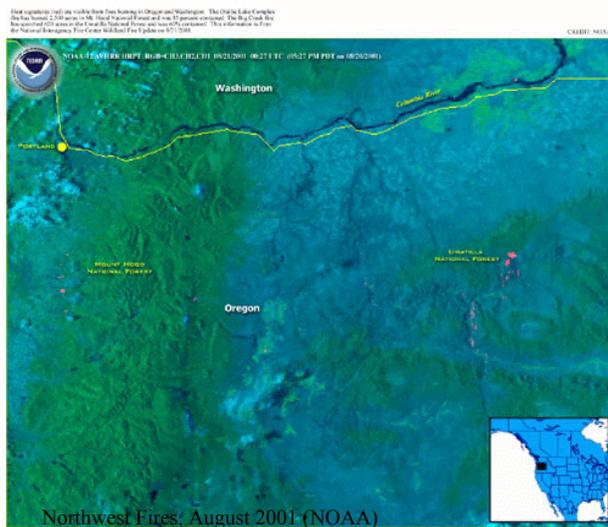


Report by the Governmental Affairs Subcommittee on  
International Security, Proliferation, and Federal Services

on

**Assessment of Remote Sensing Data Use by  
Civilian Federal Agencies**

December 12, 2001



UV Radiation Exposure, May 2001 (NASA)

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## Abbreviations Used in Report

Amtrak	National Railroad Passenger Corporation
CDC	Centers for Disease Control and Prevention
CRS	Congressional Research Service
Commerce	Department of Commerce
DEA	Drug Enforcement Agency
DOD	Department of Defense
DOE	Department of Energy
Education	Department of Education
ENRD	Environment and Natural Resource Division
EPA	Environmental Protection Agency
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
HHS	Department of Health and Human Services
HUD	Housing and Urban Development
INS	Immigration and Naturalization Service
Interior	Department of Interior
Justice	Department of Justice
Labor	Department of Labor
NAPP	National Aerial Photography Program
NASA	National Aeronautics and Space Agency
NDIC	National Drug Intelligence Center
NIH	National Institute of Health
NIMA	National Imaging and Mapping Agency
NOAA	National Oceanic and Atmospheric Agency
NRO	National Reconnaissance Organization
NSF	National Science Foundation
State	Department of State
Transportation	Department of Transportation
Treasury	Department of Treasury
USAID	U.S. Agency for International Development
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

## Executive Summary

The Senate Governmental Affairs Subcommittee on International Security, Proliferation and Federal Services requested the Congressional Research Service (CRS) to conduct a survey of remote sensing data and technology use by federal non-military agencies. The benefits of satellite data and remote sensing to the defense and intelligence communities are well known. The purpose of this study is to enable Congress to better understand how federal agencies use remote sensing and to understand the issues that arise in obtaining and applying the technology and data.

The 20 agencies surveyed for this study span the roles of the federal government from basic research centers to law enforcement. All but four report some use of remote sensing data and technology in implementing their mandated missions. The remote sensing data application cited most often was for environmental and conservation purposes, with ten agencies reporting extensive or moderate use. Seven agencies reported extensive to moderate use of remote sensing for early warning, mitigation, monitoring, and studying the impact from natural disasters. Other uses include basic and applied research, mapping activities, monitoring and verifying compliance with laws and treaties, agricultural activities, and transportation and shipping.

The agencies reporting extensive to moderate use of remote sensing data acquire the data from a variety of government and commercial sources. The most common were governmental sources, such as NASA, NOAA, and USGS. Many agencies use non-U.S. sources, such as the European Space Agency and Canadian Space Agency, as well as commercial sources, such as LandSat5, IKONO, and Orbview.

Participating agencies cited many concerns, which can be categorized as availability, access and effective use of remote sensing data and technology. Ten agencies reported availability concerns, referring to the problems and difficulties agencies experienced in getting the data needed to carry out specific tasks and missions. Twelve agencies reported access concerns, referring to the general problems associated in using data. Nine of these agencies cited cost and licensing concerns with commercial data and value-added products and analysis. Nine agencies reported concerns over their capacity to use effectively and fully exploit remote sensing data and technology, mostly due to a shortage of trained personnel within the agencies to analyze and interpret data.

Several federal civilian agencies use remote sensing data to accomplish their mandated missions. Many of these agencies cited concerns that prevent them from using remote sensing data fully. This report offers several options to alleviate these concerns, but these are not the only possible solutions. Nor are they suggestions for action. The federal government uses remote sensing data in many ways, and it is unlikely that a single solution will solve all the problems associated with this use.

This report is based on finding by the Congressional Research Service and additional work by the majority Subcommittee staff.

## Introduction

The Congressional Research Service was asked by Senator Daniel K. Akaka, Chairman of the Governmental Affairs Subcommittee on International Security, Proliferation, and Federal Services, to conduct an informal assessment of the use of remote sensing by federal non-military agencies. The purpose of this study is to enable Congress to better understand how federal agencies use remote sensing and issues that arise in obtaining and applying the technology and data. The Congressional Research Service collected information on this issue from selected departments and agencies, and compiled their responses.

For the purpose of this survey, “remote sensing” refers to the observation of the Earth from distant vantage points, usually via satellites or aircraft. Resulting data and imagery are used in many mapping and monitoring applications.

Twenty agencies were asked to answer several questions regarding their use of remote sensing data, of which nineteen agencies responded. A sample of the letter sent to these agencies is given in Appendix 1. A list of participating agencies is given in Appendix 2. These agencies have been separated into three categories: agencies reporting extensive use of remote sensing data, agencies reporting low to moderate use of remote sensing data, and agencies reporting no use of remote sensing data. If they currently utilize remote sensing, they were asked:

- I. How are these technologies and data used;
- II. Where are the data obtained (commercial or government suppliers);
- III. Do they have concerns with using remote sensing data and technology;
- IV. Are the data shared within and outside the department or agency and are there licensing concerns;
- V. What budget do they have for obtaining and using remote sensing data and technology?

Each agency response is summarized in Appendix 3. Of the 19 agencies responding, 11 reported extensive use of remote sensing data, four reported low to moderate use, and four reported no use. If the agency is not currently utilizing remote sensing, they were asked how familiar the agency or department was with remote sensing technology and data; what reasons the agency had for not utilizing remote sensing; and if the was agency examining these issues.

The responses received from the CRS inquiry varied in depth and completeness. Therefore, the results presented are not indicative of a scientific study, but rather an informal assessment of the uses and concerns by various federal agencies on remote sensing data and technology.

The final section of the report address the new issues facing remote sensing since September 11, 2001, from sources other than the CRS survey.

### 1. History of Remote Sensing Data Use by Civilian Federal Agencies

The first recorded use of remote sensing was in 1858 when French photographer Gaspard-Felix Tournachon (popularly known as Nadar) took aerial photographs of Paris from his gas balloon. Two years later, in 1860, Nadar took aerial photos of enemy troop movements for the French army during the Franco-Prussian War<sup>1</sup>. Since that time, the military has made use of aerial photographs from balloons and aircraft. Remote sensing data has a long academic research history in studying geology, the atmosphere, and weather. The early earth observation and experimental weather satellite, TIROS, was launched in 1960. It was later followed by the launch of Landsat 1 in 1972, making satellite imagery available to the general public for the first time.

There is over four decades of political and legal history on remote sensing data. In 1962, the Kennedy Administration released photos of Soviet missiles in Cuba taken from high-altitude airplanes. Those images shaped the course of the historic Cold War confrontations and demonstrated that remote sensing technologies could serve as powerful diplomatic tools<sup>2</sup>. The United Nations, in recognizing the important of the access to and use of space, passed the U.N. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and other Celestial Bodies in 1967. Article II of the Treaty states that “Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.” States cannot exert control over any part of outer space, as they do in airspace above their national territories, so that satellites are free to orbit over them. However, Article VI states that “States Parties to the Treaty shall bear international responsibility for national activities in outer space...whether such activities are carried on by governmental agencies or by non-governmental entities...”

On December 3, 1986, the United Nations passed Principles Relating to Remote Sensing of the Earth from Outer Space. The United States position had been that collection and distribution of civilian remote sensing imagery should be unrestricted. The Soviet Union position sought to ensure that acquisition and distribution of imagery should only be allowed with consent of the state that is overflown. The adopted language contained a compromise such that if a country knows that it is being imaged and requests a copy of the image, it is entitled to one at the market rate. However, the imaged country is not entitled to know who requested the specific image or for what purpose.

Over the past 30 years, the government, industry, and non-governmental organizations have used aerial and space-based imagery platforms to collect intelligence, execute military operations, plan development projects, and monitor the environment. Humanitarian applications of remote sensing data include monitoring, documenting, and possibly deterring large scale humanitarian crises. For example, in 1995, Secretary of State Madeline Albright called attention to the international community to the atrocities being committed against Bosnian Muslims.<sup>3</sup>

Satellite and aircraft have provided data on the Earth’s temperature, land cover, water bodies, and atmosphere. Remote sensing has monitored and documented the depletion of the

ozone layer over the South Pole, the shrinking Aral Sea in the former Soviet Union, and the rate of loss of the Amazon's tropical rain forest. Remote sensing data has also been extensively used by the media, industry, and urban planners.<sup>4</sup>

## 2. Remote Sensing Use by Civilian Federal Agencies

The agencies surveyed for this report span the roles of the federal government from basic research centers to law enforcement. Many of these agencies reported using remote sensing data for multiple purposes. Even with the variety of agencies, the general uses of remote sensing data can be grouped into broad categories, as defined below. How the data and technology are used by participating agencies is summarized in Table 1.

A total of ten agencies reported extensive or moderate use of remote sensing data for environmental and conservation purposes. Categorized as Natural Resource Management/Conservation/Environment, this refers to using the data and technology to monitor land, water, and air conditions, water and land usage, and environmental degradation and fishery management. For example, the USAID uses remote sensing data to monitor and track drought and flood conditions in developing countries, while FEMA uses the data to improve floodplain maps for the National Flood Insurance Program.

Seven agencies reported extensive to moderate use of remote sensing for monitoring and studying the impact from natural disasters. Several of these agencies also use the data for natural disaster early warning and mitigation. For example, the USDA's Forest Service Remote Sensing Application Center has supported programs to help fight the recent western forest fires, while the EPA has used the data to assess impacts from mining activities and oil spills.

Six agencies reported extensive to moderate use of remote sensing data and technology for basic and applied research. These agencies fund many programs for atmospheric science, oceanography, meteorology, geology, hydrology, agricultural studies, environmental science, space physics, and others.

Six agencies reported extensive to moderate use of remote sensing data and technology for various mapping activities. For example, Interior provides data to local city planners, while State uses data for diplomacy and mediation of territorial disputes. The USDA uses data to delineate farm boundaries within major domestic crop producing areas.

Six agencies reported extensive to moderate use of remote sensing data and technology for monitoring and verifying compliance with law, regulations, and treaties. For example, the EPA uses remote sensing resources to monitor pollution sources and violations, while the State actively monitors international treaties and agreements.

Five agencies reported extensive to moderate use of remote sensing data and technology for agricultural activities. USDA uses data to develop crop production estimates and conduct

natural resource inventories. Justice uses the data to identify drug producing plants, signatures for crops of interest, and domestic marijuana production.

Three agencies reported extensive to moderate use of remote sensing data and technology for transportation and shipping. Justice uses data to monitor ingress and egress to marijuana growing areas and remote waterways for specific types of vessels.

**Table 1. - Summary of Remote Sensing Data and Technology Use by Federal Agencies**

<b>Data/Technology Use</b>	<b>Agencies(extensive)</b>	<b>Agencies (moderate)</b>	<b>total</b>
Natural Resource Management/ Conservation/Environment	(7) USDA, FEMA, Commerce, Interior, State, USAID, EPA	(3) HHS, HUD, Transportation,	10
Monitor/study/quantify impacts from natural and man-made events/disasters	(5) EPA, FEMA, Interior, USAID, State	(2) Transportation, HHS	7
Basic & Applied Research	(6) NSF, USDA, EPA, Commerce, NASA, DOE	n/a	6
Mapping functions	(5) USDA, FEMA, Interior, USAID, State	(1) HUD	6
Early warning/mitigation of natural events and disasters	(5) USDA, FEMA, State, Interior, USAID	(1) HHS	6
Monitoring compliance/verification of laws, regulations, treaties	(5) USDA, Justice, Commerce, State, EPA	(1) Treasury	6
Agricultural use	(4) USDA, Interior, USAID, Justice	(1) HHS	5
Transportation/shipping	(2) Justice, Commerce	(1) Transportation	3
Conflict Resolution	State	n/a	1

### 3. Remote Sensing Data Sources

Agencies acquire data from a variety of government and commercial sources. The most common were governmental sources from NASA, NOAA and USGS. NIMA, U.S. Air Force, and general DOD resources were also cited, but these were mostly used in emergencies or required unclassified data. Several agencies used data from non-U.S. governmental sources, such as the European Space Agency, the Canadian Space Agency and the National Space Development Agency of Japan. American commercial remote sensing data sources repeatedly cited were Space Imaging (LandSat5 and IKONOS) and ORBIMAGE (OrbView). Non-U.S. commercial sources, such as the French SPOT, Indian IRS, European Remote Sensing Satellite, and the Canadian Space Agency's RADARSAT were also cited. A full list of data sources by agency is given in Appendix 4.

#### 4. Agency Concerns

Agency concerns can be categorized as availability, access, and effective use of remote sensing data and technology. These concerns are summarized in Table 2.

Availability concerns refer to the problems and difficulties agencies may experience in getting the data that they need to carry out their missions. Several agencies cited problems due to the limited number of satellites collecting specific data sets, the time necessary to get data, and limit coverage and continuity of locations. Other agencies, such as State and USAID, had concerns with getting the technology and equipment necessary for remote sensing data use to all their offices and partners.

Access concerns refer to problems in using data in general. Several agencies cited concern with the cost and licensing issues associated with commercial data and value-added products and analysis. In fact, the cost of commercial data is the most common concern among federal agencies who use remote sensing data. Some agencies also found their access restricted to "sensitive" data.

Effective use concerns refer to problems associated with agencies fully exploiting remote sensing data and technology. Several agencies cited problems with training and retaining qualified staff and lack of equipment. Some research agencies, such as NSF, NASA and Commerce, are concerned with a lack of assurance in "ground-truth" and calibration of commercial data.

**Table 2 - Summary of Agency Concerns in Using Remote Sensing Data and Technology**

<b>Availability Concerns</b>	<b>Agencies (Extensive)</b>	<b>Agencies (Moderate)</b>	<b>Total</b>
Relatively few satellites collecting data needed	(3) USDA, EPA, NSF	Transportation	4
Time needed to get data in useful form OR availability of data from specific time period	(3) FEMA, NSF, Interior	Transportation	4
Availability of Aerial data (time/location)	(4) NSF, NASA, Interior, EPA	n/a	4
Continuity of a specific data source	(3) USAID, USDA, Interior	n/a	3
Weather/cloud cover	(3) Commerce, FEMA, NASA	n/a	3
Availability in proper format (digital vs photography)	(2) USAID, State	n/a	2
Reliance on complex and expensive technology/training not available globally	(2) USAID, State	n/a	2

<b>Access Concerns</b>	<b>Agencies (Extensive)</b>	<b>Agencies (Moderate)</b>	<b>Total</b>
Cost of commercially available data	(7) Interior, USDA EPA, NSF, FEMA, USAID, DOE	(2) HHS, Transportation	9
Licensing concerns in sharing commercial data	(4) Commerce, Interior, State, USAID, NSF, USDA	Transportation	7
Some data classified “sensitive”, security data	(2) NSF, State	Transportation	3
Cost of processing/value-added data	(2)Interior, DOE	n/a	2

<b>Effective Use Concerns</b>	<b>Agencies (Extensive)</b>	<b>Agencies (Moderate)</b>	<b>Total</b>
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Lack of in-house expertise and difficulty in attracting and retaining specialists	(4) EPA, USDA, Interior, USAID	HHS	5
Calibration/ground truth problems (especially for research agencies using commercial data)	(3) Commerce NASA, NSF	HHS	4
Lack of knowledge within agency at user level of how data can be used	(2) EPA, Interior	Transportation	3
Lack of equipment/software for analysis and interpretation	(3) EPA, Interior, State	n/a	3
Volume of data (storage, archiving, etc.)	NSF	n/a	1
Resistance within agency to change	EPA	n/a	1

## 5. Data Sharing and Licensing Concerns

Many agencies share data within their organization and need to be able to share these data with their partners. Partners include local, state, federal governments, international governments, and non-government organizations. Some agencies only use data that would allow them to do this freely, while others, that require specific commercial data sources, opt to have agreements with the data vendors who would give them the flexibility they need. A summary of data sharing and licensing concerns by participating agency is given in Appendix 5. When possible, details regarding specific agency data sharing and licensing remarks have been taken directly from the agency survey response.

## 6. Agency Budgets for Remote Sensing Data and Technology

It is difficult to compare or assess the funds spent on remote sensing data and technology across civilian federal agencies. In most cases, costs are dispersed among programs and projects and agencies did not report an overall budget for remote sensing data and services. Research agencies, such as NASA and NOAA, included costs of satellite hardware, ground stations, and infrastructure, which greatly increases their remote sensing budgets. Budget information provided by participating agencies is listed in Table 3.

**Table 3 - Agency Remote Sensing Data and Technology Budget Information**

<b>Agency/ Department</b>	<b>Budget (millions)</b>	<b>Description</b>
USAID	n/a	Money is set in individual programs for data, software, personnel, etc.
USDA	\$38.3 (FY00)	Total remote sensing outlays
Commerce (NOAA)	\$560	Funds NOAA's operational satellite programs, ground systems, infrastructure
DOE	\$13 K	Yearly cost of high-resolution cloud field data sets. Other data used is free from NASA and NOAA.
EPA	\$14.6 \$1.0	Generic geospatial products and services (\$2.0 million for actual data) For historical aerial photography interpretation
FEMA	n/a	Remote sensing support obtained using disaster funds associated with support Presidentially declared emergencies. Programmatic remote sensing has been limited in the last few years.
HUD	\$2.4 (FY01) \$5.2 (FY02)	Spent to set up E-map prototype and other applications. Estimated need to implement and expand applications.
HHS	n/a	Individual image costs are dispersed among projects.
Interior (USGS)	\$59 (FY99)	Remote sensing activities (staffing equipment, purchase and maintenance of systems, data purchase and analysis) dispersed throughout agency at the project/program level.
Justice	\$35.5 (FY01) \$55.5 (FY02)	INS activities, only. Other agencies within Justice could not provide budget information. Expected FY02 appropriations for INS activities.
NASA	\$1485 (FY01) \$751 (FY01)	Total Non-systems/instrumentation Budget (including scientific research, educations, maintenance of data systems, mission operations, etc.)
NSF	\$1 \$3.5	Provided for aircraft instrumentation. Provided for remote sensing data purchases.
State	n/a	Does not have internal budget process to increase availability and access of data and no consensus as to the size of budget request required to increase use.

Transportation	\$8 (FY01)	Transportation appropriated data and technology budget (including Coast Guard).
Treasury	n/a	Budget information not provided.

## 7. Agencies Reporting No Use of Remote Sensing Data and Technology

Of the four agencies reporting no use of remote sensing data and technology, three (Department of Education, Amtrak, and Department of Labor) stated that such data were not relevant to their mission. Both the Department of Education and Amtrak are not using nor are they currently examining future use of remote sensing because it is not relative immediately to their tasks. The Department of Labor does not use remote sensing data but is in partnership with NASA and other federal agencies in the National Workforce Development and Training Initiative (NWDETI) to assist in the development of remote sensing technology through education. The group is defining the technology field and developing curricula for teaching and training educators and workers. An initial defining conference was held January 29-February 1, 2001, with the Department of Labor and several other federal agencies represented. This work continues with NASA taking the lead.

The Peace Corps currently does not use remote sensing data, although it is familiar with the technology. The majority of the work at the Peace Corps is localized at overseas posts where a lack of technology, equipment and infrastructure makes most remote sensing images too advanced for local projects. The agency plans to research the possibilities of using these technologies after overseas computer and communication infrastructure is upgraded.

## 8. Recommendations and Conclusions

Several federal civilian agencies use remote sensing data and technology to accomplish their mandated missions. These agencies use data for mapping activities, law enforcement evidence, basic and applied research, monitoring of international treaties and agreements, and mitigating the aftermath of natural and manmade disasters. Many of the agencies have concerns and have identified problems associated with remote sensing data use that limits the full exploitation of the technology. A chief concern is the cost of commercial satellite data that is often complimentary to federal and publicly available data sources. There are two aspects to addressing this concern: data could be made more affordable, or, agencies could have more funds to pay for the information.

Commercial data costs are due to the cost of building, launching, and operating a spacecraft as well as making raw data useful by various consumers. The Space Enterprise Council, a component of the U.S. Chamber of Commerce that advocates for and represents the commercial space industry, proposes to reduce costs to individual agencies and programs by

increasing the demand for such data and spreading the hardware/software investment across many users. The Council suggests increasing awareness within federal agencies of their need for remote sensing and geospatial products and services, which would lead to a willingness to fund these requirements. The Council also recommends committing funds necessary for federal government infrastructure for effective use of commercial data and increasing funding for individual agencies expressly for data and services. The Space Enterprise Council maintains that the government should move to outsourcing remote sensing products and services from the commercial sector, thereby encouraging competition between commercial sector entities rather than with civilian agency satellites.<sup>5</sup>

However, a few agencies expressed concern over not having specific data set available. Some agencies needed specific areas covered at specific times, which can be difficult due to satellite targeting and observing constraints. Some were also concerned that the specific kind of information required was not available because existing instruments and space craft did not meet their specifications. Others had “ground-truth” or calibration concerns and were not confident in the raw data or processing methods used. Many of these agencies perform basic and applied research and therefore have very specific requirements for any data set if it is to be useful. It is likely that these agencies will always require a suite of custom-made instruments for satellites and aircraft to get the data they need.

Another way to reduce costs of data is to allow government agencies to arrange licenses and sharing agreements in bulk. This could involve establishing an agency or office that will act as a clearing house for remote sensing data products, funded solely to purchase data from commercial sources for use by federal agencies. Several agencies may require the same data which could now be purchased once for federal use. On a smaller scale, agencies could alternatively establish an internal office to handle data purchasing, licensing, budgeting, and handling. An example of this is NASA’s 1997 Science Data Buy, managed by NASA Stennis Space Center, that has five commercial firms on contract to supply land imaging data from both satellites and aircraft.

Many agencies were also concerned about not having the personnel needed to manipulate the data fully. Several agencies do not have the in-house expertise (Interior, USAID). These agencies want analyzed data, with the appropriate maps and information included in the image, so that it may be used immediately. Other agencies are having difficulties in retaining trained personnel (EPA, USDA). This concern could be addressed in several ways. Agencies could be given funding expressly to hire and retain qualified personnel to handle remote sensing data requests within each agency, or, trained and qualified personnel resources could be pooled in one place. The clearing house office mentioned above could have a role in both commercial and public data by taking data requests by federal agencies, finding the appropriate source, and providing it back to the requesting agency in a form needed.

Most agency concerns related to issues that limit fully exploiting such data so that it could be used more widely and liberally. A few agencies also cited cultural problems from within, ranging from a lack of appreciation for remote sensing data potential; sub-optimal

organizational structures for intra-agency communication; regulatory system inertia that tends to resist change; fragmented decision making; and concerns by non-governmental partners and industry that remote sensing data may reveal new data that could put them in violation of the law.

The recommendations given above are not the only possible solutions, nor are they suggestions for action. The federal government uses remote sensing data in many ways, solving all the problems associated with this use will require more than a single solution. While participating agencies had many concerns with using remote sensing data, they also had many uses. This survey and report addresses civilian use of remote sensing data. Since the first photographs of enemy troop positions from a hot air balloon in 1860, there have been military and intelligence applications of remote sensing data. Military and intelligence agencies will continue to make up the majority of remote sensing data and technology use by the federal government. However, to quote David B. Sandalow, Assistant Secretary of State for Oceans, Environment and Science, “whether in defending the nation against military attack, promoting public health, protecting the environment or responding to humanitarian disasters, remote sensing has a role.”<sup>6</sup>

## 9. Remote Sensing Data Uses and Concerns since September 11, 2001

The remote sensing community has participated in many activities during and after the terrorist attacks of September 11, 2001. The community has responded to thousands of map requests and have worked with officials and other communities to address the following questions:

- I. What is the demographic impact? Where are people displaced and in what numbers?
- II. What is the impact to infrastructure?
- III. How can impacted areas be accessed? Where should displaced people go?
- IV. What is the thermal activity and displacement of the debris field?

One issue realized by the remote sensing community while trying to respond to the terrorist attacks was the importance of interoperability between different data sets. The requested information needed to be provided quickly, especially to be used in response and evacuation plans, and in a form that was easily used by city and state officials.<sup>7</sup>

Many remote sensing data providers, both within the government and private industry, are now faced with new concerns as a result of the terrorist attacks. NIMA and Space Imaging have signed a contract that gives NIMA exclusive rights to images taken of Afghanistan by the Ikonos satellite.<sup>8</sup> Commercial and government data providers are also questioning what domestic data should continue to be provided publicly on the internet and what data are too dangerous to have readily available in addition to the problems uncovered while trying to

quickly and efficiently combine government (publicly accessible) and private data sets during an emergency.

Federal, state and local officials have different roles in homeland security and terrorism response. The federal government is responsible for detection and prevention of terrorist attacks, while state and local groups will carry out preparedness and response. Remote sensing can be used in all these activities and remote sensing providers are beginning to address these demands.

## Appendix 1 - sample letter sent to agencies

January 18, 2001

Assistant Secretary for Congressional Relations  
Office of Congressional and Intergovernmental Relations  
United States Department of Agriculture (USDA)  
Jamie L. Whitten Building, 14th & Independence Ave., SW  
Washington, D.C. 20250

Dear Assistant Secretary:

We are contacting you on behalf of Senator Daniel K. Akaka to request your assistance in an informal assessment of the use of remote sensing by federal non-military agencies. This study will enable Congress to better understand how federal agencies are using remote sensing, and issues that arise in obtaining and applying the technology and data. Senator Akaka has asked the Congressional Research Service (CRS) to collect information on this issue from selected departments and agencies, and to compile and analyze those responses. He is the ranking Democrat on the Governmental Affairs Subcommittee on International Security, Proliferation and Federal Services.

For the purposes of this request, “remote sensing” refers to the observation of the Earth from distant vantage points, usually via satellites or aircraft. Resulting data and imagery are used in mapping and monitoring human- and naturally-induced changes in weather, climate, and environmental conditions, among other applications. If your Department is currently utilizing remote sensing, we would like to know: (1) how these technology and data are used; (2) from where they are obtained (commercial or government suppliers); (3) pros and cons experienced in using remote sensing; (4) how and whether the technology and data are shared within and outside the Department; (5) any data licensing concerns; and (6) budgets associated with obtaining remote sensing data and technology. If your Department is not utilizing remote sensing, please tell us about: (1) the Department’s familiarity with remote sensing technology and data; (2) reasons the Department is not utilizing remote sensing; (3) if such technology and data might help to meet Department goals and objectives in the future; and (4) whether such issues are being examined.

In order to respond to the Senator’s request, we would appreciate it if your Department could write a brief response to each of these relevant factors, and submit them to CRS by March 1, 2001. We also ask that you please work with all relevant agencies and offices within the Department so that we can gain the most comprehensive information possible. In addition, we would appreciate receiving copies of any studies, reports, or documents that specifically address your use of remote sensing.

If you have any questions about this request, you may contact Marcia Smith, Specialist in Aerospace and Telecommunications for CRS (202-707-7076), or Sherri Stephan, Legislative Fellow for the Senate Subcommittee on International Security, Proliferation and Federal Services (202-224-

5443). Thank you so much for your assistance with this matter, and we look forward to receiving your responses.

Sincerely,

Daniel P. Mulhollan  
Director

## Appendix 2 - List of Participating Agencies

### Agencies reporting an extensive use of remote sensing data and technology (11 of 19):

U.S. Agency for International Development (USAID)  
U.S. Department of Agriculture (USDA)  
    Agriculture Research Service  
    Farm Service Agency  
    Foreign Agriculture Service  
    Forest Service  
    National Agricultural Statistical Service  
    Statistics Service  
    National Resources Conservation Service  
Department of Commerce (Commerce)  
    National Oceanic and Atmospheric Agency (NOAA)  
Department of Energy (DOE)  
Environmental Protection Agency (EPA)  
Federal Emergency Management Agency (FEMA)  
Department of Interior (Interior)  
    Bureau of Indian Affairs  
    Bureau of Land Management  
    Bureau of Reclamation  
    Minerals Management Service  
    Office of Surface Mining and Reclamation and Enforcement  
    National Park Service  
    U.S. Fish and Wildlife Service  
    U.S. Geological Survey (USGS)  
Department of Justice (Justice)  
    Federal Bureau of Investigation (FBI)  
    Drug Enforcement Agency (DEA)  
    National Drug Intelligence Center (NDIC)  
    Environment and Natural Resources Division (ENRD)  
    Immigration and Naturalization Service (INS)  
National Aeronautics and Space Agency (NASA)  
National Science Foundation (NSF)  
Department of State (State)

### Agencies reporting moderate use of remote sensing data and technology (4 out of 19):

Department of Health and Human Services (HHS)  
    Centers for Disease Control and Prevention (CDC)  
    National Institute of Health (NIH)  
Housing and Urban Development (HUD)

Department of Transportation (Transportation)  
Coast Guard

Department of Treasury (Treasury)  
Secret Service  
Customs

Agencies reporting no use of remote sensing data and technology (4 out of 19):

Department of Education  
Department of Labor  
National Railroad Passenger Corporation (Amtrak)  
Peace Corps

## Appendix 3 - Agency Response Summaries

The text in the summaries below was provided by the Congressional Research Service and is paraphrased or taken verbatim from the written responses.

### Departments and Agencies Reporting Extensive Use of Remote Sensing Data

#### ***U.S. Agency for International Development (USAID):***

USAID identified more than 20 activities that make use of satellite and other forms of remote sensing technologies and data. Many of these activities are carried out through private-sector firms. Some are conducted in cooperation with other federal agencies and hence may be reported by them as well.

**Concerns raised:** USAID provided description of individual activities, with each description answering each of the questions posed in the letter. Examples of the concerns raised in those individual responses are the following: the reliance on complex and expensive technology available to Western countries but often beyond the means of African countries; reduced availability of low resolution imagery from U.S. government satellites, while commercial imagery is more expensive; uncertainty regarding the future of landsat for providing medium resolution imagery; difficulty in attracting and retaining specialists; licensing concerns in sharing data from commercial providers; and some data not available in digital form.

#### ***U.S. Department of Agriculture (USDA):***

USDA provided input from several Services and Agencies within the Department (see Participating Agencies List). Each of those agencies uses remote sensing data for different goals and objectives. Among them is delineating farm boundaries within major domestic crop producing areas; developing crop production estimates in major international crop producing areas; providing early warning of potential domestic crop disasters; monitoring compliance with farm program rules; conducting natural resource inventories, conservation planning and wetland delineations; managing natural resources; and accomplishing basic and applied research.

**Concerns raised:** Among the concerns identified are: continuity and availability of data; attracting and retaining trained staff; cost; and the relatively few number of satellites that obtain the data.

#### ***Department of Commerce (Commerce):***

The National Oceanic and Atmospheric Administration (NOAA) is the primary agency within the Department that operates and uses data from remote sensing systems. NOAA provides time critical data and products utilizing this remote-sensing technology. Imagery, collected data, and derived products are also provided to NOAA weather forecasters and U.S. environmental decision-makers for severe weather forecasting and tracking; they are integral to disaster

mitigation products, fisheries monitoring, and ship routing industries.

**Concerns raised:** Lack of “ground truth”; clouds (for non-meteorological applications); precise calibration; accurate navigation; inference of what is really there versus direct measurement; data obtained from non-NOAA satellites and through interagency and international agreement subject to licensing and distribution restrictions; and significant licensing and distribution restrictions on data purchased from commercial providers.

***Department of Energy (DOE):***

DOE extensively uses remote sensing data from NASA and NOAA satellites for measuring aerosol and cloud optical properties to understand the role of clouds and radiation in the General Circulation Models and climate research.

**Concerns raised:** High cost of obtaining high spatial resolution data is single biggest drawback to using more data. Another deterrent is the cost to develop algorithms to provide operational products.

***Environmental Protection Agency (EPA):***

EPA’s largest use of remote sensing data and technology is in research areas; however regional and other program offices have been making strides in applying the data and imagery. For example, this data is useful in assessing impacts from mining activities, responding to oil spill emergencies, and assessing the effects of land use on aquatic ecosystems. EPA states that it expected to complete a “Geospatial Activities Baseline Assessment” in the late spring 2001 that was expected to provide a “thorough examination and inventory of the applications of geospatial data and technology across the agency.” It also expects to publish a “Remote Sensing Roadmap” in 2001 to provide “a plan for developing EPA’s use of imagery.”

**Concerns raised:** Lack of knowledge at the user level (technical and administrative) of how remote sensing can be used to address their questions and issues; cost; lack of equipment and software for basic interpretation and lack of expertise; lack of sufficient monitoring resources; need for technical training and experience; need to build the capacity to understand and apply new technologies as well as to solicit and communicate needs and requirements; sub-optimal organizational structures at federal agencies of intra-agency communication; regulatory system inertia that tends to resist change; fragmented decision making; and concerns by companies that remote sensing data may reveal new data about environmental conditions and reveal unknown pollution that could put them in violation of the law.

***Federal Emergency Management Agency (FEMA):***

FEMA’s Mitigation Directorate, Information Technology Services (ITS) Directorate, and Response and Recovery (R&R) Directorate use remote sensing in various ways. Among the functions for which FEMA uses such data are: collection of data for disaster and emergency

response operations and analysis; mapping floodplains as part of the National Flood Insurance Program; examination of physical changes along coastal plains; analyzing the results of erosion/restoration efforts; and analyzing Emergency Managers' data requirements and the level of accuracy needed to fill Emergency Support Information Requirements.

**Concerns raised:** Data can be expensive; effective exploitation of data can be time-consuming; and data collection can be adversely affected by weather and cloud cover.

***Department of Interior (Interior):***

U.S. Geological Survey (USGS) responded on behalf of the Department. USGS archives and distributes data for Landsat satellites and operates Landsat 7 as part of its joint management of the Landsat 7 program with NASA. The Department has used remotely sensed data and technology for decades, beginning with aerial photography in the 1930's and 1940's. New data sources and analysis approaches have expanded the scope and diversity of applications within the Department.

**Concerns raised:** Several obstacles to fully using remote sensing data were identified in a recent survey of USGS users of such data, including; cost of the data itself, and cost to process and use it; difficulty in ordering and acquiring data; insufficient access to appropriate software; difficulty in identifying best type of data to use/or determine its applicability; lack of expertise; data not available for time period needed; lack of analytical staff; and restrictions on sharing/redistribution of proprietary data.

***Department of Justice (Justice):***

The Federal Bureau of Investigation (FBI) and Drug Enforcement Administration (DEA) are the major users of remote sensing data in the Department. The FBI uses aerial remote sensing data as investigative tools, and maintains liaisons with the National Reconnaissance Office (NRO), the National Imagery and Mapping Agency (NIMA), and commercial satellite companies in order to remain current on new satellite technology and capabilities. DEA has been using remote sensing since the 1970's, for example, to: identify drug producing plants, monitor ingress and egress to marijuana growing areas; monitor pedestrian trails; and monitor remote airfields and waterways for specific types of aircraft and vessels. DEA uses commercial satellite systems for example to provide remote mapping data for remote areas of the world, and multispectral and hyperspectral signatures for crops of interest. In addition, the National Drug Intelligence Center uses drug production estimates prepared by another government agency using remote sensing data and has studied expanded use of remote sensing data for detecting domestic marijuana production. The Environment and Natural Resources Division uses aerial photograph in the course of litigation, and, on occasion, satellite imagery. (The Immigration and Naturalization Services reported on its use of electronic sensors and imaging devices, but these appear to be ground-based).

**Concerns raised:** None identified.

### ***National Aeronautics and Space Administration (NASA):***

NASA has pioneered and advanced the field of remote sensing over the last 40 years. Also, the use of such data is fundamental to scientific research and applications within NASA's Earth Science Enterprise (ESE). ESE has a research program to increase knowledge of the Earth system; an applications program to demonstrate practical use of earth system information to decision-makers in governments, businesses, and elsewhere; and a technology program to enable new or lower cost capabilities for the study of the earth system in the future. Most of the data used by NASA and its funded investigators are from NASA satellites, aircraft, and balloons.

**Concerns raised:** Need to re-calibrate periodically satellite sensors; data not always available in a timely manner; geophysical or biological parameters are indirectly derived rather than directly measured; and remote sensing satellites may not be suitable for collecting data on high latitude areas, requiring supplementary aerial data.

### ***National Science Foundation (NSF):***

NSF-supported scientists use remote sensing data from satellites and aircraft for many research purposes. Satellite data are from NASA, NOAA, or non-U.S. Satellites; aircraft data from commercial sources or NSF-supported aircraft operated by the National Center for Atmospheric Research.

**Concerns raised:** Satellite data are valuable, but there are not enough satellites to provide the coverage needed for a number of research and/or operational applications. Other issues are: cost; volume of data (in terms of the ability to process, store, and manipulate it); inability to obtain real-time data in some cases; delays in obtaining data; some data may be classified "sensitive" for national security reasons; aerial data offer flexibility but data sets are limited in time and space; and commercially supplied data might have quality problems if researchers are not allowed sufficient oversight in data gathering and processing procedures.

### ***Department of State (State):***

State uses remote sensing data (acquired, analyzed, and processed by other government agencies) for purposes such as diplomacy/mediation of international conflicts arising from territorial disputes; support for projects that promote sustainable development; provision of data to partner countries in the aftermath of natural disasters; monitoring international environmental treaties, agreements, and initiatives; and humanitarian relief.

**Concerns raised:** access to commercial imagery is limited by restricted licensing agreements; lack of interoperability between data suppliers; limited access to computer technology and the Web in many parts of the world; lack of training in partner countries; and extensive coordination with intelligence agencies needed to obtain authorization to use imagery derived products.

### **Departments and Agencies Reporting Low to Moderate Use of Remote Sensing Data**

### **Health and Human Services (HHS):**

The Centers for Disease Control and Prevention's (CDC) Agency for Toxic Substances and Disease Registry (ATSDR) uses remote sensing data for public health applications, primarily in infectious diseases and environmental health, including as a backdrop for Geographic Information System (GIS) projects. GIS is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e. data identified according to their locations. CDC's Long Island Breast Cancer Study uses a GIS database. The National Institute of Health's (NIH) National Cancer Institute (NCI) uses GIS technology to develop new approaches to estimating indirect exposure to pesticides and for estimating exposure to nitrates in private wells. NIH's Fogerty International Center (FIC) uses remote sensing data for identifying priority locations for collection of natural products drug discovery materials and prediction of likely areas of disease outbreak and/or disease complications.

**Concerns raised:** ATSDR states that the expense of the satellite imagery restricts its use. If more funds were available, would/could use this technology more liberally. NCI cites lack of in-house technical expertise and costs associated with using the data, such as the need for "ground truth" and personnel with required expertise. FIC lists cost and availability of images as significant barriers to increased use of the technology.

### ***Housing and Urban Development (HUD):***

HUD does not use satellite photographs, but does has a GIS application that combines EPA data and HUD project data to provide computerized maps on the Internet to promote "healthy communities" by making the public more aware of environmental hazards near population concentrations. HUD could incorporate satellite photographs with this application. State and local governments have offered aerial views of their cities.

**Concerns raised:** None identified.

### ***Department of Transportation (Transportation):***

Transportation and NASA have a Memorandum of Understanding to work together to implement a fully integrated and coordinated research program on applying remote sensing to transportation. It seeks innovative applications of commercial remote sensing and geospatial information technologies to solve priority transportation requirement. Also, the Coast Guard uses remote sensing data in three major areas: Threats to the Environment, Post Natural Disaster Assessment, and Navigation Safety. Data are obtained from commercial and government sources.

**Concerns raised:** Transportation notes that technology outpaces applications. The Department is working to both raise awareness of the potential of the technology to solve transportation problems as well as develop guidelines on how to use the technology to solve issues. The Coast Guard cites concerns with sharing issues (either classification or licensing issues), infrequent

revisit time caused by orbit or number of sensors, and the cost and timeliness of commercial sensors. Regarding licensing constraints, the Coast Guard states that commercial data can only be shared with specific end-users without incurring additional expense, severely limiting the usefulness of the data.

***Department of Treasury (Treasury):***

The Secret Service uses remote sensing information from the National Imagery and Mapping Agency for security planning. The Customs Service uses data from aircraft radar and infrared equipment to track aircraft, vessels, and vehicles suspected of smuggling activity. Treasury responses also discusses use of the Global Positioning System.

**Concerns raised:** None identified.

Departments and Agencies Reporting No Use of Remote Sensing Data:

***Department of Education:***

The Department is not using nor is it currently examining future use of remote sensing because it is not immediately relevant to its mission.

***Department of Labor:***

The Department does not use remote sensing data, but is in partnership with NASA and other federal agencies in the National Workforce Development and Training Initiative (NWDETI) to assist in the development of remote sensing technology through education . Other federal agencies involved in the NWDETI are the Smithsonian Institution, the National Geographic Society, the Public Broadcasting Service, and the Global Learning and Observations to Benefit the Environment Program. The group is defining the technology field and developing curricular for teaching and training educators and workers.

***National Railroad Passenger Corporation (Amtrak):***

Amtrak is not involved in this type of research.

***Peace Corps:***

The Peace Corps does not currently use remote sensing, although it is familiar with this technology. The majority of the work at the Peace Corps is localized at overseas posts and most remote sensing images are too advanced for these local projects. The agency plans to research the possibilities of using these technologies after overseas computer and communication infrastructure is upgraded.



Appendix 4 - List of Data Sources

Agency/ Department	US Government Data Source	Non-US and Commercial Data Source
<b>USAID</b>	NOAA, NASA, DOD, USGS, aerial,	Space Imaging (LANDSAT 5, IKONOS), SPOT (France), EUMETSAT (Meteosat), RADARSAT (Canada), EARTHSAT (LANDSAT TM), IRS (India), OKEAN-O (Russia/Ukraine), commercial aerial
<b>USDA</b>	USGS, NOAA, NASA, USAF, DOD, aerial (NAPP)	IRS (India), SPOT (France), Space Imaging (LANDSAT 5, IKONOS), commercial aerial
<b>Commerce</b>	NOAA, DOD	Space Imaging (IKONOS), OrbView, several foreign weather/environ. satellites
<b>EPA</b>	USGS, NOAA, NASA, aerial, NIMA (emergency & research only)	SpaceImaging, SPOT (France), commercial aerial
<b>FEMA</b>	USGS, DOD, NIMA (emergency only), aerial	n/a
<b>DOE</b>	NASA, NOAA	n/a
<b>HHS</b>	USGS	n/a
<b>Interior</b>	NOAA satellites, USGS Landsat NASA Terra/GOES, aerial	SPOT (French), IRS (India), RADARSAT, European Remote Sensing Satellite, OrbView2, Ikonos, aerial photography
<b>Justice</b>	NIMA, NRO, aerial (NAPP, NASA, USGS)	commercial satellite data, commercial aerial
<b>NASA</b>	NASA, aerial (NAPP)	some commercial
<b>NSF</b>	NASA, NOAA	Canadian, European and Japanese government satellites, commercial aerial

<b>State</b>	NASA, NOAA, NIMA, USGS, NRO (in times of emergency)	Space Imaging (LANDSAT 5) , OrbView, RADARSAT (Canada)
<b>Transportation</b>	NASA	some commercial
<b>Treasury</b>	NIMA, aerial (Coast Guard)	n/a

## Appendix 5 - Licensing Concerns

**USAID** works with several Federal agencies, such as USDA and NOAA, to provide support for many overseas activities. It has many international partners, many of whom cannot afford licensing agreements and find these costs prohibitive. USAID freely shares government data sources but cannot share purchased commercial data.

**USDA** has an agreement with some commercial data providers so that these data can be shared within the Department through the USDA Satellite Imagery Database. The USDA Satellite Imagery database was established in 2000 to focus the purchasing, distribution, and archiving of remotely sensed data used by several agencies within the department. USDA value-added products derived from remote sensing area are also shared with other organizations and the public. Additionally, USDA agencies distribute maps, in hardcopy and electronic format, depicting remotely sensed data. Web-based applications are currently being developed by several USDA agencies to facilitate data sharing across the Internet. Partnerships, where appropriate, have been formed between USDA and other federal and state agencies to reduce cost of acquiring data.

Licensing concerns vary significantly among agencies within the USDA. USDA-wide data licenses are available for some data sets which have increased the effectiveness of the USDA Satellite Imagery database. However, USDA can not obtain agreements for all data which hampers sharing of data within the department. The National Resource Conservation Service and Forest Service note that data licenses can restrict the ability of these agencies to share data with the public. Finally, the National Resources Conservation Service cannot afford to purchase satellite imagery because licenses are so restrictive.

**Commerce** mostly uses data obtained by NOAA satellites which is publicly available and free through a variety of sources, such as satellite broadcasts, websites, archives, and NOAA's National Data Centers. Commerce is free to use data obtained by NOAA unless restricted by license agreements with commercial vendors or other countries. Data obtained from non-NOAA satellites and through interagency and international agreements are subject to the licensing and distribution restriction of the host agency or country. For example, some data may be restricted to research use and may not be available for public distribution. Data purchased from commercial providers generally include significant licensing and distribution restrictions which may impact the utility and cost of data.

**DOE** generally uses NOAA and NASA data which are not restricted and available to researchers for free, and does not have licensing concerns.

**EPA** is working on ways to improve how remote sensing data and technology are shared within the Agency. There are several information systems and programs that collect and distribute remote sensing and geospatial data, information and products. EPA Office of Research and Development provides technical services to the Agency regarding remote sensing and technology. In many cases, the Superfund program and Superfund personnel in the Regions

have most utilized these services. This support includes the collection, processing, and analysis of remote sensing data from both aircraft and spacecraft. In addition, EPA has several outreach efforts to improve how the data are shared. EPA has also held workshops and training to communicate developments and demonstrate the use and application of geospatial data and technology.

Currently, EPA has specific licensing agreements with each commercial provider that vary with respect to how much sharing is allowed. EPA delegates much of its monitoring authority and responsibilities to the States which in turn send their environmental information back to EPA. Therefore, a licensing arrangement that permit sharing of data between EPA and a State is important. In addition, EPA needs to share data with the 10 EPA regions, each with multiple states, requiring sharing of data across states for regional assessment. Under most license agreements, it is often very expensive for EPA to share data with state partners, potentially impeding implementation of national plans. Finally, EPA requires licensing agreements that allow sharing of processed imagery with the local government and the public, as it is mandated to do. Therefore, products derived from images and value-added services must also be distributed.

**FEMA** is responsible for coordinating the Federal Response Plan. In that capacity, all agencies within the Federal Response Plan are required to coordinate planned remote sensing activity with FEMA, regardless of its source. This requirement serves two primary functions: it eliminates potential duplication of effort, and it ensures that anticipated/generated remote sensing products and information are made available to the maximum number of potential Federal and State users. FEMA makes every effort to deliver remote sensing imagery or information to the requester. However, circumstances may not always accommodate preferences. For example, large paper copies of aerial imagery may be requested, but delivery may be unavailable because of limitation on a transportation system caused by a disaster. Another potential problem is the size of many digital images which prohibits transfer of data across standard email.

All data FEMA purchases (or shares the cost of purchase with a Federal partner) must be allowed to be freely distributed without restriction. Data obtained through NIMA are taken from classified sources but are derived and therefore do not represent any data licensing concerns.

**HHS** remote sensing activity is done within the CDC and NIH. CDC obtains most of its imagery from the USGS at minimal expense. CDC also obtains high resolution data from other Federal sites at no cost. Funding limitations prohibit extensive use of imagery and so it is reserved only for sites that will clearly benefit from its use. If more funds were available for the use of remote sensing data in the public health assessment process, they would use this technology more liberally. NIH uses data in active research that are not shared beyond the Agency and contractors.

**HUD** primary remote sensing activity are HUD E-maps, combining EPA data with HUD

project data to allow the public and federal, state and local agencies to formulate queries of HUD housing and community development data. HUD E-maps and other applications are available on the Internet. HUD has been using their own and other Federal government data, namely EPA and Census, which do not have licensing issues.

**Interior** has a variety of coordinating activities and cooperative programs that foster use within the Department. Examples of such cooperation include the Interior Geographic Data Committee Remote Sensing Working Group (USGS chairs), and the Interior High-Priority Digital Base Data Program. Additionally, Interior actively participates in a number of activities that promote cooperation and coordination of remote sensing use across federal agencies, such as the National Aerial Photography Program, the National Digital Orthophoto Program, and the Multi-Resolution Landscape Characterization Program. Interior also participates in international remote sensing coordination activities and programs.

In general, Interior is concerned that a lack of coordination may cause different agencies to sign license agreements to use commercial data with different terms. Specific licensing concerns within USGS can be extended across Interior. USGS draws upon a wide range of data to support its programs. These data are typically collected by USGS personnel, its partners, or under contract with a variety of commercial vendors. Historically, the vast majority of data used and information derived is government property, placed in the public domain by the USGS, and shared with other agencies. However, privately available licensed data offers potential advantages in terms of timeliness, information, content, and ease of analysis over traditional sources. Potentially higher costs and use/distribution limitations present challenges to effective use of licensed data. License restrictions might limit the extent to which the source data are released for public access and are used to verify the analysis that leads to policy decisions. Licensing agreements may make use of data by USGS researchers prohibitive, which is contrary to the scientific process that demands full and open access to the basic project data. The concept of using commercial data to revise periodically and update information on USGS maintained national, public-domain databases may be untenable due to the difficulty of managing a mix of licensed and unlicensed data products within large, freely exchanged public domain databases. Finally, data collection in support of disaster response requires almost immediate distribution and duplication to a wide range of agencies, which must be accommodated by any license agreement.

Within **Justice**, the FBI Physical Surveillance Unit maintains liaison with the National Reconnaissance Office (NRO), NIMA and commercial satellite companies for current satellite technology and capabilities. DEA uses its own surveillance aircraft as well as commercial satellite data. ENRD commonly uses aerial photographs from the USGS, USDA, and NASA. Justice agencies did not report any licensing or data sharing concerns.

**NASA** extensively shares remote sensing data and technology within the Agency and its network of funded investigators and contractors through open solicitations and based on scientific and technical peer reviews. All NASA-produced data is non-copyrighted and free from licensing restrictions. Data purchased from commercial sector generally carries restrictions

to protect private sector capital investment.

Outside NASA, data are shared without any restrictions with U.S. Federal Agency, international, and recently, State and Local government partners. Over the last decade, NASA has devoted considerable resources to the improvement of “access” to its remote sensing data and associated software and technology. NASA’s Earth Science Enterprise supports a variety of organizations that provide substantial support for sharing of remote sensing data and technology and improving access. These include the Distributed Active Archive Centers, the Earth Science Information Partners, and the Regional Earth Science Application Centers. Technology is often developed in partnership with other Federal partners and private industry. These arrangements are made via mechanisms such as Memoranda of Understanding, contracts, grants or cooperative agreements. Unlike data, technology information is not shared internationally beyond what is required to accomplish joint missions and is subject to established export control laws and regulations.

**NSF** mostly uses government satellite data that is open and available for reproduction costs. NSF-supported aircraft data generally are made available to the entire scientific community and are readily accessed on NSF-supported databases. Licensing of data is a concern for private sector and foreign sources. This is of concern not only for expense, but also for restrictions on satellite positioning and other technical factors that make the optimal data unavailable. NSF feels that the U.S. Government should continue to push for a “free and open” international exchange of data.

**State** has shared imagery-derived products with partner governments during national disasters and in public diplomacy. Differentiation between intelligence and non-intelligence agencies in commercial satellite licensing agreements poses a particularly vexing problem for State. As a result, the same imagery is sometimes purchased multiple times or cannot be shared between different offices and bureaus inside the Departments. This tends to restrict the utility and increase the cost of the data. An Interagency Commercial Imagery Working Group, hosted by State, is currently discussing ways to resolve this problem. Outside the Department, data is shared according to interagency and international agreements that follow the restrictions set by the commercial licenses for unclassified data.

**DOT** has implemented a research program in partnership with leading academic institutions, service providers, and industry for remote sensing in transportation. Transportation and NASA have entered into a Memorandum of Understanding to work together to implement a fully integrated and coordinated research program on applying remote sensing to transportation. Transportation has not yet experienced any problems relating to data licensing.

Within Transportation, the Coast Guard shares data within the Transportation and with other agencies depending on their needs and release issues. Due to licensing constraints, commercial data can only be shared with specific end-users without incurring additional expense. This severely limits the usefulness of the data and the Coast Guard’s ability to distribute products to the widest possible consumer group.

**Transportation** uses NIMA data for security planning for the Secret Service, and USGS aircraft data to track suspected smuggling activity. Transportation did not report any sharing of data within the Department or with outside partners, or any licensing concerns.

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